

## Claims

What is claimed is:

1. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having an inlet opening and a generally cone-shaped depression for receiving and guiding a tip of a needle toward the inlet opening, the generally cone-shaped depression having an average angle of convergence within the range of about 60° and about 150°.

2. An infusion device as recited in claim 1, wherein the angle of convergence of the generally cone-shaped depression is about 150°.

3. An infusion device as recited in claim 1, wherein the inlet opening is provided at the apex of the generally cone-shaped depression.

4. An infusion device as recited in claim 1, wherein the generally cone-shaped depression has a depth within the range of about 0.02 inch and about 0.09 inch.

5. An infusion device as recited in claim 1, wherein the generally cone-shaped depression has a depth of about 0.05 inch..

6. An infusion device as recited in claim 1, wherein the inlet structure further comprises:

a septum disposed in relation to the inlet opening, to seal the inlet opening, the septum having a recess and a thickness dimension; and

a support member disposed within the recess of the septum to support the septum, the support member having a thickness dimension;

wherein, at least a portion of the thickness dimension of the support member within the recess overlaps a portion of the thickness dimension of the septum to reduce the combined thickness of the septum and support member.

7. An infusion device as recited in claim 6, wherein the entire thickness of the support member is disposed within the recess in the septum, such that the combined thickness of the septum and support member is not greater than the thickness of the septum.

8. An infusion device as recited in claim 1, wherein the inlet structure further comprises:

a septum having a central portion disposed in relation to the inlet opening, to seal the inlet opening, the septum further having an annular recess disposed around the central portion and a thickness dimension; and

a support member disposed within the recess of the septum to support the septum against deformation, the support member having a generally rigid annular body with a thickness dimension and a central opening for allowing a needle to pass through the septum and the support member;

wherein, at least a portion of the thickness of the support member within the recess overlaps a portion of the thickness of the septum to reduce the combined thickness of the septum and support member.

9. An infusion device as recited in claim 8, wherein the entire thickness of the support member is disposed within the recess in the septum, such that the combined thickness of the septum and support member is not greater than the thickness of the septum.

10. An infusion device as recited in claim 1, wherein the inlet structure further comprises:

a septum having a side disposed in relation to the inlet opening, to seal the inlet opening;

a moveable valve member disposed on the opposite side of the septum relative to the side of the septum that seals the inlet opening, the valve member being moveable between a first state in which the valve member contacts the septum and a second state in which the valve member is spaced from the septum to define a volume space between the septum and the valve member; and

means for imparting a force on the valve member to urge the valve member against the septum.

11. A device as recited in claim 10, wherein the moveable valve member has a first surface for contacting the septum when the valve member is in the first state, the first surface of the moveable valve member having a depression for receiving a tip of a needle passed through the inlet opening and the septum, the depression in the first surface of the valve member having a depth within the range of about 0.01 inch and about 0.05 inch.

12. A device as recited in claim 11, wherein the depression in the first surface of the valve member has a depth of no more than about 0.03 inch.

13. A device as recited in claim 10, wherein the moveable valve member has a first surface for contacting the a tip of a needle passed through the inlet opening and the septum to move the valve member to the second state, wherein upon the valve member being in the second state, the distance between the first surface of the valve member and the septum is no greater than about 0.075 inch.

14. A device as recited in claim 11, wherein the moveable valve member has a second surface and a recess in the second surface and wherein the means for imparting a force comprises a spring partially disposed within the recess in the second surface of the valve member.

15. A device as recited in claim 10, wherein the means for imparting a force on the valve member comprises a spring having a generally low profile.

16. A device as recited in claim 10, wherein the means for imparting a force on the valve member comprises a wave compression spring.

17. A device as recited in claim 10, wherein the means for imparting a force on the valve member comprises at least one of the group consisting of a wave compression spring, a belview spring, a crescent spring, a conical coil spring, a leaf spring, and an elastomeric fill material.

18. A device as recited in claim 10, wherein the moveable valve member has a first surface for contacting the septum when the valve member is in the first state, and wherein the septum includes at least one rib disposed to contact the first surface of the valve member upon the valve member being in the first state, for improving a seal between the septum and the valve member upon the valve member being in the first state.

19. A device as recited in claim 18, wherein the at least one rib comprises an annular rib.

20. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having an inlet opening, a septum and a support member;

wherein the septum has a thickness dimension and a recess and is disposed in relation to the inlet opening, to seal the inlet opening;

wherein the support member has a thickness dimension and is disposed within the recess of the septum to support the septum, such that at least a portion of the thickness of the support member overlaps a portion of the thickness of the septum to reduce the combined thickness of the septum and support member.

21. An infusion device as recited in claim 20, wherein the entire thickness of the support member is disposed within the recess in the septum, such that the combined

thickness of the septum and support member is not greater than the thickness of the septum.

22. A device as recited in claim 20, wherein:

the septum has a central portion disposed in relation to the inlet opening, to seal the inlet opening;

the recess in the septum comprises an annular recess disposed around the central portion; and

the support member comprises a generally rigid annular body with a central opening for allowing a needle to pass through the septum and the support member.

23. An infusion device as recited in claim 22, wherein the entire thickness of the support member is disposed within the annular recess in the septum, such that the combined thickness of the septum and support member is not greater than the thickness of the septum.

24. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having an inlet opening, a septum, a moveable valve member and means for imparting a force on the valve member to urge the valve member against the septum;

wherein the septum has a side disposed in relation to the inlet opening, to seal the inlet opening;

wherein the valve member is disposed on the opposite side of the septum relative to the side of the septum that seals the inlet opening, the valve member being moveable between a first state in which the valve member contacts the septum and a second state in

which the valve member is spaced from the septum to define a volume space between the septum and the valve member;

wherein the moveable valve member has a first surface for contacting the a tip of a needle passed through the inlet opening and the septum to move the valve member to the second state; and

wherein upon the valve member being in the second state, the distance between the first surface of the valve member and the septum is no greater than about 0.075 inch.

25. A device as recited in claim 24, the first surface of the moveable valve member having a depression for receiving a tip of a needle passed through the inlet opening and the septum, the depression in the first surface of the valve member having a depth within the range of about 0.01 inch and about 0.05 inch.

26. A device as recited in claim 25, wherein the depression in the first surface of the valve member has a depth of no more than about 0.03 inch.

27. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having an inlet opening, a septum, a moveable valve member moveable between a first state and a second state, and means for imparting a force on the valve member to urge the valve member toward the first state;

wherein the moveable valve member has a first surface for contacting the septum when the valve member is in the first state, and wherein the septum includes at least one rib disposed to contact the first surface of the valve member upon the valve member being in the first state, for improving a seal between the septum and the valve member upon the valve member being in the first state.

28. A device as recited in claim 27, wherein the at least one rib comprises an annular rib.

29. A device as recited in claim 27, wherein:  
the inlet structure further comprises a cup-shaped member in which the septum, the moveable valve member and the means for imparting a force are disposed;  
the septum includes at least one second rib contacting the cup-shaped member for improving a seal between the septum and the cup-shaped member.

30. A device as recited in claim 29, wherein the septum comprises a generally disc-shaped member having an outer peripheral edge and wherein the at least one second rib comprises a peripheral rib disposed around the outer peripheral edge of the generally disc-shaped member.

31. A device as recited in claim 29, wherein the inlet structure further includes a cap member having an inner surface disposed adjacent the septum and wherein the septum includes at least one third rib contacting the inner surface of the cap member for improving a seal between the septum and the cap member.

32. A device as recited in claim 32, wherein the septum includes a central portion disposed adjacent the inlet opening to seal the inlet opening and wherein the at least one third rib comprises an annular rib surrounding the central portion of the septum.

33. A device as recited in claim 27, wherein the inlet structure further includes a cap member having an inner surface disposed adjacent the septum and wherein the septum includes at least one further rib contacting the cap member for improving a seal between the septum and the cap member.

34. A device as recited in claim 33, wherein the septum includes a central portion disposed adjacent the inlet opening to seal the inlet opening and wherein the at least one further rib comprises an annular rib surrounding the central portion of the septum.

35. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having an inlet opening, a septum, a cup-shaped member in which the septum is disposed;

the septum includes at least one rib contacting the cup-shaped member for improving a seal between the septum and the cup-shaped member.

36. A device as recited in claim 35, wherein the septum comprises a generally disc-shaped member having an outer peripheral edge and wherein the at least one rib comprises a peripheral rib disposed around the outer peripheral edge of the generally disc-shaped member.

37. A device as recited in claim 35, wherein the inlet structure further includes a cap member having an inner surface disposed adjacent the septum and wherein the septum includes at least one further rib contacting the inner surface of the cap member for improving a seal between the septum and the cap member.

38. A device as recited in claim 37, wherein the septum includes a central portion disposed adjacent the inlet opening to seal the inlet opening and wherein the at least one further rib comprises an annular rib surrounding the central portion of the septum.

39. A device as recited in claim 37, wherein the cap member comprises a threaded surface and the cup-shaped member comprises a further threaded surface and wherein the threaded surfaces of the cap member and the cup-shaped member are coupled together in a threaded manner.



40. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having a septum and a cap member provided with an inlet opening;

wherein the cap member has an inner surface disposed adjacent the septum and wherein the septum includes at least one rib contacting the inner surface of the cap member for improving a seal between the septum and the cap member.

41. A device as recited in claim 40, wherein the septum includes a central portion disposed adjacent the inlet opening to seal the inlet opening and wherein the at least one further rib comprises an annular rib surrounding the central portion of the septum.

42. A device as recited in claim 40, wherein:

the inlet structure further includes a cup-shaped member in which the septum is disposed;

the cap member comprises a first threaded surface and the cup-shaped member comprises a second threaded surface ;

the threaded surfaces of the cap member and the cup-shaped member are coupled together in a threaded manner.

43. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having a septum, a cap member provided with an inlet opening, and a cup-shaped member in which the septum is disposed;

wherein the septum has a surface in contact with the cap member, adjacent the inlet opening, to seal the inlet opening;

wherein the cap member comprises a first threaded surface and the cup-shaped member comprises a second threaded surface coupled to the first threaded surface of the cap member in a threaded manner; and

wherein the threaded coupling of the first and second threaded surfaces may be tightened or loosened by rotating the cap member and the cup-shaped member relative to each other, to adjust the seal of the septum against the cap member.

44. A device as recited in claim 43, wherein the septum includes at least one rib contacting the cap member for improving a seal between the septum and the cap member.

45. A device as recited in claim 44, wherein the septum includes at least one further rib contacting the cup-shaped member for improving a seal between the septum and the cup-shaped member.

46. An infusion device for delivering infusion medium to a patient and for receiving infusion medium from a hollow needle during a fill or re-fill operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having a septum, a moveable valve member moveable between a first state and a second state, a spring tensioned to impart a force against the moveable valve member to urge the valve member toward the first state, a cap member provided with an inlet opening, and a cup-shaped member in which the septum, valve member and means for imparting a force are disposed;

wherein the septum has a first surface in contact with the cap member and a second surface defining a valve seat in contact with the valve member

wherein the cap member comprises a threaded surface and the cup-shaped member comprises a further threaded surface coupled to the threaded surface of the cap member in a threaded manner; and

wherein the threaded coupling of the threaded surfaces of the cap member and cup-shaped member may be tightened or loosened by rotating the cap member and the cup-shaped member relative to each other, to adjust the tension of the spring and the spring force against the valve member.

47. A system for filling or re-filling an infusion device, comprising:

a generally hollow needle having a generally hollow interior, a needle shaft terminating in a tip end and an opening on the needle shaft in fluid flow communication with the interior of the needle, the needle further having a converging portion between the needle shaft and the needle tip, wherein the distance between the needle tip and the needle opening is within the range of about 0.01 inch and about 0.05 inch;

an infusion device housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure including an inlet opening, a septum having a first side disposed in relation to the inlet opening to seal the inlet opening, and a moveable valve member disposed on the opposite side of the septum relative to the first side of the septum, the valve member being moveable between two maximum end points of movement respectively defining a first state in which the valve member is adjacent the septum and a second state in which the valve member is spaced from the septum relative to the first state to define a volume space between the septum and the valve member;

wherein the inlet opening has a dimension large enough to allow the needle to pass through the inlet opening and through the septum to contact and move the moveable valve member;

wherein the moveable valve member has a first surface for contacting the a tip of a needle passed through the inlet opening and the septum to receive a force from the needle

to move the valve member to the second state, wherein upon the valve member being in the second state, the distance between the first surface of the valve member and the septum is no greater than about 0.05 inch.

48. A system as recited in claim 47, wherein the moveable valve member has a first surface for contacting the septum when the valve member is in the first state, the first surface of the moveable valve member having a depression for receiving a tip of a needle passed through the inlet opening and the septum, the depression in the first surface of the valve member having a depth within the range of about 0.01 inch and about 0.05 inch.

49. A system as recited in claim 47, wherein the distance between the needle tip and the center of the needle opening is about 0.025 inch.

50. An infusion device for delivering infusion medium to a patient and for receiving a hollow needle during a fill, re-fill operation or medium withdrawal operation, the device comprising:

a housing having a reservoir portion for containing a volume of infusion medium and an outlet through which infusion medium may be dispensed; and

an inlet structure provided in fluid flow communication with the reservoir portion of the housing, the inlet structure having a cap member provided with an inlet opening through which a needle may pass during a fill, re-fill or medium withdrawal operation, the inlet structure further including a septum disposed on one side of the inlet opening and having a central portion through which a needle may pass during a fill, re-fill or medium withdrawal operation;

wherein the septum includes a tapered surface facing the cap member and wherein the cap member includes a tapered depression for engaging the tapered surface of the septum and imparting a force directed toward the central portion of the septum, upon the septum being pressed against the cap member.

51. An infusion device as recited in claim 50, further comprising a cup-shaped member in which the septum is disposed, the cup shaped member having a threaded surface, wherein the cap member includes a threaded surface configured to threadingly

engage the threaded surface of the cup-shaped member and wherein the septum is disposed between the cup-shaped member and the cap member and is pressed against the cap member upon the cup-shaped member and cap member being threadingly tightened together.

52. An infusion device as recited in claim 51, wherein:

the cap member has a hollow interior and an inner peripheral surface on which the cap member threads are located;

the cup-shaped member has an outer peripheral surface on which the cup-shaped member threads are located; and

the cup-shaped member extends into the hollow interior of the cap member upon the cup-shaped member and cap member being threadingly tightened together.

53. An infusion device as recited in claim 50, wherein the tapered surface of the septum comprises a generally conical-shaped surface and wherein the tapered depression in the cap member comprises a generally conical-shaped depression.

54. An infusion device as recited in claim 53, wherein the septum further comprises a generally flat, annular surface around the generally conical-shaped surface.

55. An infusion device as recited in claim 54, wherein the cap member has a generally flat, annular surface around the generally conical depression, for engaging the generally flat, annular surface of the septum.